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ABSTRACT

The fourth part of a 10-part series, this report was compiled by the Educational Development Center at Wilkes College. The series deals with various aspects of the treatment of delinquents and is intended as a summary of research findings in each of the areas treated. Each report was prepared by a scholar-practitioner and is presented in a way that will be of value to professionals who deal both directly and indirectly with the treatment of delinquent youth. The report is, in fact, one manuscript of 627 pages; however, to make it more easily used, it is published in 10 separate parts. A detailed table of contents for the entire series is presented at the end of each part. This part deals with the teaching of mathematics to delinquent youth. It describes a number of important dimensions of an academic program for this population, and discusses the interface of content areas with these dimensions. Several specific math teaching programs are analyzed, and methods for setting up a math lab are set forth. (Author)

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THE TREATMENT OF DELINQUENCY SERIES

AN EDC REPORT

CHAPTER 4

Mathematical Programming for Delinquent Youth

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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Les Sternberg
and
Robert A. Sedlak

Northern Illinois University

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Editor's Preface

This report is part of a ten part series compiled by the Educational Development Center at Wilkes College. The series deals with various aspects of the treatment of delinquents and is intended as a summary of research findings in each of the areas treated. Each report was prepared by a scholar-practitioner and is presented in a way that will be of value to those whose calling has led them to educational careers dealing both directly and indirectly with the treatment of delinquent youth. The report is, in fact, one manuscript of 627 pages; however, to make it more easily used, it is published in ten separate parts. A detailed table of contents for the entire series is presented at the end of this part.

Additional copies of this part as well as other parts of the series are available from the Educational Development Center, Wilkes College, Wilkes-Barre, Pennsylvania 18703. Permission is granted for bona fide users to reproduce any part of the document. We ask only that the user exert care to preserve the integrity of the document and do justice to the authors by crediting quotations used to the author who prepared the original work.

We invite any and all comments and/or inquiries concerning this series.

Joseph A. Skok, D.P.A.

Director
Educational Development Center

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CHAPTER IV

MATHEMATICAL PROGRAMMING FOR DELINQUENT YOUTH

Les Sternberg and Robert A. Sedlak

This chapter will discuss diagnosis and remediation of arithmetic difficulties in norm violating institutionalized and public school youth. An attempt will be made at familiarizing the reader with information related to past educational practices in this area, the academic achievement characteristics, learner aptitudes, and needs assessment regarding this population as they interact with the essential components of a mathematics program. An effort will be made to describe each of these components so that a mathematics program can be implemented in practice by the reader. The emphasis will be on a workable scheme for ameliorating the academic difficulties that adjudicated youth face in this achievement area.

Overview of Academic Characteristics

The institutionalized delinquent presents a number of pressing academic problems to educators aside from specific social and

behavioral disturbances. Teachers working with this population are often bombarded with "theoretical" models purporting to explain the causes of and remedial techniques contrived to reduce the behavioral disturbances which they exhibit. Little information, however, is available on ameliorating the academic disturbances related to mathematics. This blatant oversight is especially obvious when comparisons are made in the amount of time spent on remediation of mathematical problems as associated with alleviating reading problems. Most assuredly this is due to the assumption that all that is needed in mathematics programming for the delinquent is instruction in computation (i.e., mechanics). The basic fallacy with this type of programming is that the delinquent often experiences failure within the mode of instruction utilized. This failure merely leads chronically disruptive youth through a downward spiral typified by a lack of successful programming that is also exhibitied in other academic areas. The absolute result is a fear of failure and negative attitude toward school in general, and numerical processes specifically.

Consideration of academic and academic-related characteristics of this population should also be discussed before dealing with the overriding concern for effective diagnosis and programming in mathematics. Mauser (1974) cites four basic demographic descriptions of delinquent youth. They are as follows: (1) the average age of today's delinquent is 13.5 years; (2) the average IQ of today's delinquent is 95, this falling within the range of average intelligence; (3) today's

delinquent, upon referral to court, has had approximately seven years of education in the public school; and (4) today's delinquent usually portrays a discrepancy of two to four years between achievement potential and actual achievement. Given these characteristics, Mauser states the following:

> The concepts of learning disabilities and juvenile delinquency have been separately discussed and investigated often. Both have been regarded by various writers as being "cause" and "effect" concepts defying simple solutions primarily resulting from the heterogeneity of the youths within each category. Obviously, the youths regarded as learning disabled and the individuals regarded as juvenile delinquents may be one and the same. Whether one causes the other and holds a priority position in terms of cause-effect relationships should not be belabored. In the future, the rehabilitative treatment design with delinquent youth will very possibly include remedial education components to assist the individual delinquent in overcoming those specific learning disabilities that may be exhibited in his behavior.
>
> (Mauser, 1974, p. 391)

To support the above contention of a similarity between learning disabilities and juvenile delinquency, Mauser continues to specify school-related characteristics exhibited by delinquent youth. Of prime importance is a delinquent's dislike for school and the teacher, for school subjects that require repetitive effort, and for school doctrines that mandate memorization. These characteristics also are found in children with learning disabilities. Poremba (1967) found that half of the court-referred juvenile delinquents exhibit characteristics of learning disability. Duling, Eddy, and Risko (1970) report essentially the same results (53%) with their population of delinquent youth.

Ahlstrom and Havighurst (1971) found that delinquent youth tend to be approximately three years behind in skill development involved in reading and mathematics. This finding is supported by Feldhusen (1973).

Because of the obvious similarities between the population of individuals considered delinquent and the population of individuals considered learning disabled, Mauser supports the belief that in terms of academic remediation, a learning disability model could prove to be effective in diagnosis and amelioration of specific academic difficulties. Inherent in this thought is the speculation that the past emphasis on incarceration without programming be totally discouraged.

Kvaraceus (1968) cites a number of factors regarding the school as a propagator of delinquent patterns of behavior. One is his contention that the school often emphasizes the need of children to exhibit high levels of verbalization and abstraction. The problem is that delinquent youth often do not bring this capability to the academic situation. Therefore, an emphasis on these undeveloped or underdeveloped abilities leads the delinquent to exhibit further behavioral "inadequacies." Silberberg and Silberberg (1971) believe that appropriate curricular intervention with the delinquent population must emphasize concrete experiences, the relating of those experiences to vocational programming, and the development of socialization skills within the framework of total programming.

In summary, there tends to be a rather strong consensus of opinion that delinquent youth and the student with specific learning disabilities exhibit not only commonalities in academic behaviors, but also present similarities in terms of reactions to school and specific needs for success in academic achievement. If this is the case, a concentrated effort should be undertaken to implement instructional models and programs with institutionalized delinquents that have been employed with the learning disabled student. The problem may be in discovering an effective model in mathematics instruction.

Programming Models for Delinquent Youth

Although one may find an enormous amount of literature pertaining to curricular programming for elementary, primary, or intermediate aged handicapped children, there are very few academic programs available for adolescent handicapped or delinquent youth. This paucity of academic programs may be due in part to differing philosophies or models through which the delinquent is viewed and treated. Rhodes (1972) has described several of these philosophies or models. The first is the biological-medical model which views the youth's behavior as being caused by specific inherent (i.e., genetic, neurological) processes. Treatment in this case emphasizes a "direct" attempt at eliminating these causes of behavior (i.e., drugs).

Education, then, is viewed as an "after the fact" methodology once treatment has been initiated. The second approach is the rational-affective model which supports the supposition that thoughts and feelings cause a youth's behavior. The basic approach used to deal with children in this case is one that attempts to discover the inward emotions which are responsible for the individual's behavior (i.e., through psychotherapy). Again, education is looked upon as a post hoc phenomenon. Third is the behavioral model which views the child as behaving because of some consequences of that behavior. The child learns an undesirable behavior because in the past it has been reinforced. The importance of this model is that it leads directly into specific teaching strategies. Treatment and education, then, are linked together into one educational framework. The fourth and last approach is the ecological model which views the child within a total environmental milieu. While environmental "change" is the key to this model, many educators view this model as too complex in working with children in that the environment itself is too complex.

Kauffman (1974) contrasts the educational model with the treatment model and states that the issue is no longer one of value of education to behaviorally disordered children but one of curricular designs. He cites a number of key approaches to use in the education of these types of children. Two extremely important alternatives are as follows: (1) relevant experience curricula, where emphasis is on the application of a curriculum to practical or applied situations, the

purpose being to teach functional academics and social skills development in real life situations; and (2) specially designed curricula for behaviorally disordered children. These two alternatives exist because past curricular approaches have dealt with a modification of the standard curricula program based upon the similarities that exist between the learning of disturbed children and normal children.

Hunter (1972) stresses the need for a specialized curriculum and has outlined three categories of innovative practices to be used in the classroom: structure (school and classroom organization); content (subject matter); and process (socialization or interaction). Hunter makes the following statement:

> . . . The possibilities inherent in any innovation in content or structure cannot be duly realized without accompanying changes in the third area, that of process. Furthermore, . . . what is currently most needed in our schools is, in fact, process change.
>
> (Hunter, 1972, p. 15)

Hunter then describes a number of needed process innovations. One is the interaction between pupil and teacher which requires the pupil to display imaginative thought rather than simple memorization. Another is the interaction between pupil and teacher, which emphasizes the sequential development of necessary skills. Still others are decision-making (both teacher and pupil), cooperation instead of competition, and cooperative success (pupil-to-pupil).

Dimensions of an Academic Program

Based upon the preceding discussion of the academic characteristics of adjudicated youth and program models for treating this population, a total academic program would need to accommodate the following six components. These are: (1) flexibility; (2) relevance to the real world; (3) a diagnostic/prescriptive format; (4) concept and skill emphasis; (5) social skill development; and (6) management and/or treatment free. These six elements would need to be considered regardless of the curricular area being planned. An operational definition of these six elements is provided.

Flexibility. This component mandates that the curriculum provides the teacher with a variety of options or procedures for presenting information to a learner and, in addition, providing the learner with a variety of ways to respond. Since many adjudicated youth are extremely poor readers, the curriculum should be designed so that being a non-reader will not penalize learning mathematical concepts.

In regard to traditional math programs, usually the "flexibility" aspect, which would accommodate learner needs, is absent. Traditional basal text programs follow an "age-in-grade" model. This means that they expect a 13-year-old in the eighth grade to be performing in all academic areas as most other 13-year-olds. If a particular

13-year-old is reading at a fifth or sixth grade level, he may be unable to read his eighth grade math book. He is penalized in learning math due to a reading problem. A sad characteristic of most traditional basal mathematics programs is that from grade level to grade level all aspects of the texts become more involved, e.g., the math, reading, vocabulary, sentence structure, etc. A flexible curriculum would need to provide ways to circumvent the problems associated with increasing reading difficulty throughout the program.

Relevancy. As Kauffman (1974) has stated, the content of the curriculum needs to provide useful types of experiences for the learner. True-to-life simulations and examples are to be preferred to the story-book types of activities found in many conventional mathematics programs. Dropping the learner down to a level where he is able to understand the material may not be fruitful because the interest value of the material changes considerably.

Diagnostic/Prescriptive Format. A diagnostic/prescriptive format means that the assessment is directly aligned with specific objectives and content in the curriculum. The plan for instruction for each learner is based upon the results of pre-assessment tests that are criterion referenced. Global achievement tests are not designed to provide the type of information that is needed to plan for short-term instructional goals. There are few commercially available instruments that are designed for this purpose. Several that are available which operate from a diagnostic/prescriptive base will be reviewed later in

this chapter. For the most part, however, the instruments will have to be "teacher constructed."

Concept and Skill Emphasis. Rote memorization of facts and principles may satisfy short-term needs of a learner; but if the expected end product is for that learner to make use of what he has learned after he leaves school, the material must have meaning. Students can be taught "tricks" to get the correct answers to verbal problems or to solve complex mathematical computations. These tricks usually cannot be successfully implemented in the real world. The focus of the curriculum, then, should be built upon the development of concepts that will help a learner function satisfactorily after he leaves school, e.g., evaluating the possible consequences of his own behavior.

Enhancement of Social Skills. Adjudicated youth quite obviously have exhibited, in the past, behaviors that are socially unacceptable. Activities which develop decision making, discrimination, social responsibility, cooperation, sportsmanship, etc., can be built into a curriculum.

Independent of Management Procedure. Described earlier in this chapter were four models for treating behaviorally disordered youth (biological-medical, rational-affective, behavioral, and ecological). It is desirous that the curriculum not come into conflict with the management model being adhered to since most institutions operate their treatment procedures based on one of these four models.

Some math curricula contain specific management procedures. For example, the use of DISTAR would be very compatible with an institution following a behavioral model, but may run into conflict with a biological-medical model operation.

Content Components of a Mathematics Program for Delinquent Youth

Bartel (1975) has reviewed and evaluated a number of commercially available math programs that might be useful with children with behavioral problems. She has also modified and summarized the Mathematics Content Authority List: K-6 (Primes, 1971) which delineates relevant math concepts and skills which would constitute a comprehensive set of content for most mathematics programs. The list is a good beginning point for building a math curriculum. The five dimensions discussed in the preceding section need to be interfaced with content, and modifications made accordingly.

Interfacing Content with Dimensions

One of the most crucial dimensions discussed previously when planning an academic curriculum was to allow for "flexibility." Cawley and Vitello (1972) have described an instructional system in mathematics that effectively incorporates this flexibility component into the

curriculum. The mechanism for accomplishing this feat is called the Interactive Unit (IU). (See Figure 1.) The IU describes the interaction which takes place between the teacher and pupil and emphasizes the affective component of mathematics instruction. The IU graphically shows the four ways a teacher may present material to the learner and the four ways in which the learner may respond to or interact with the teacher. In presenting a mathematical task to the student, a teacher can construct something, present a picture or prearranged set of something, say something, or write something. The pupil, in terms of interacting with the teacher, can construct something, identify something, say something, or write something. There are, therefore, sixteen possible instructional interactions between teacher and pupil. This provides the student with the opportunity to demonstrate acquisition of a specific arithmetic concept through a number of interactive channels. Even with a child who is a functional non-reader, there are twelve options available to the teacher for presenting the information and getting a response. The teacher would stop presenting material that required reading to the youth.

Another component of the mathematics system described by Cawley and Vitello (1972) that incorporates the flexibility principle is the manner in which verbal problems can be written which systematically control for a variety of crucial variables (that is, reading level, computational difficulty, distracting information, etc.). A

FIGURE 1

INTERACTIVE UNIT MODEL

* Input (Teacher)	constructs	presents	states	graphically symbolizes (writes)
Output (Student)	constructs	identifies	states	graphically symbolizes (writes)

* In certain instances, another student may provide input.

discussion of how this can be attained will be described later in the chapter.

A third and a fourth component of the Cawley-Vitello model that meet the flexibility requirement are the learning unit and the cognitive processing unit which describe a number of factors: (1) different types of learning and learning styles and (2) cognitive processes that are inherent in different kinds of instructional strategies. The instructional systems component basically outlines different types of materials or methodologies to be employed in the curriculum. Also, an emphasis is placed on the evaluation of student performance within the instructional systems.

Diagnosis

A shortcoming of most evaluation systems in mathematics is their failure to correlate student performance in a program with student performance on an assessment battery. The following section will provide an overview of diagnosis as it pertains to mathematics programming.

It is imperative that diagnosis be looked upon as one segment of a continuous process leading toward effective instructional programming in mathematics skill development for delinquent youth. Teachers are usually faced with results from various diagnostic batteries,

usually in the form of achievement tests, that give supposed indications of where a child is presently functioning. Results are often states in grade equivalent or age equivalent scores. Occasionally, a student's performance is reported in terms of how he compares with others of his same age (scaled scores or percentile ranks). The obvious teacher's question stemming from such reports is "What should I now teach the child?" Any report of a student's performance on a diagnostic test or inventory related to attained mathematical skills is basically useless unless some type of preferred instructional programming is recommended. To state a child's grade or age equivalent score or his scaled score indicates where the child stands in relation to the norm group. However, this statement does not permit real direction into the teaching process. What is needed, then, is a specification of a student's individual academic-related behaviors so that prescriptive instruction based upon those behaviors can ensue.

Another consideration must be given to an explanation of what generates the results of most diagnostic tests. The essential question is what PERFORMANCES or BEHAVIORS are being measured to justify the score? Too often the assumption is made that this is not a necessary question. In the past the emphasis in diagnosis of mathematical abilities has been in the area of computation. It seemed all that was necessary to measure a student's achievement level in mathematics and to diagnose his strengths and weaknesses within this area was to measure how well he could compute with whole numbers and

fractions and how well he could use computation to solve basic verbal problems. To design a diagnostic instrument based upon this assumption was indeed a very easy task.

It seems rather obvious that there is much more to mathematical ability than mere computation and its use. To show that a student can add, subtract, multiply, and divide does not necessarily show that a child understands these operations. He could be simply following a rote computational habit without any regard to the rationale encompassing that operation or the necessary reasoning involved in such operations. Care must be taken, therefore, in finding instruments or developing instruments that give a much more in-depth analysis of covert abstract conceptualizations and reasoning skills leading toward overt behavioral performances indicating correct usage of these covert processes.

What is being recommended, then, is the use of diagnostic instruments (1) that provide a depiction and delineation of specific mathematical behaviors through behavioral or performance objectives and (2) that somehow indicate or prescribe instruction based upon a student's performance on a given formal or informal instrument or behavior observation device. At the present time, norm referenced diagnostic tests or achievement tests do not meet these two requirements. The only appropriate path to follow seems to be in the use of criterion-referenced and concept-referenced tests or inventories. The former measure the acquisition of specific behaviors, prescribe

instruction toward those behaviors, and then test acquisition of the behaviors; while the latter measure a behavior and relate successful performance of that behavior to various instructional concepts related to that behavior. See Figure 2 for examples of these two methods.

A basic premise of the diagnostic/prescriptive teaching model has been that the contents of tests used in the assessment procedure should be directly correlated with instructional alternatives. The following section will deal with four innovative diagnostic/prescriptive systems that attempt to ameliorate some of the problems existing in current mathematics programs. Each is an attempt at not only making mathematics meaningful but also meeting specific non-academic needs of the youngster.

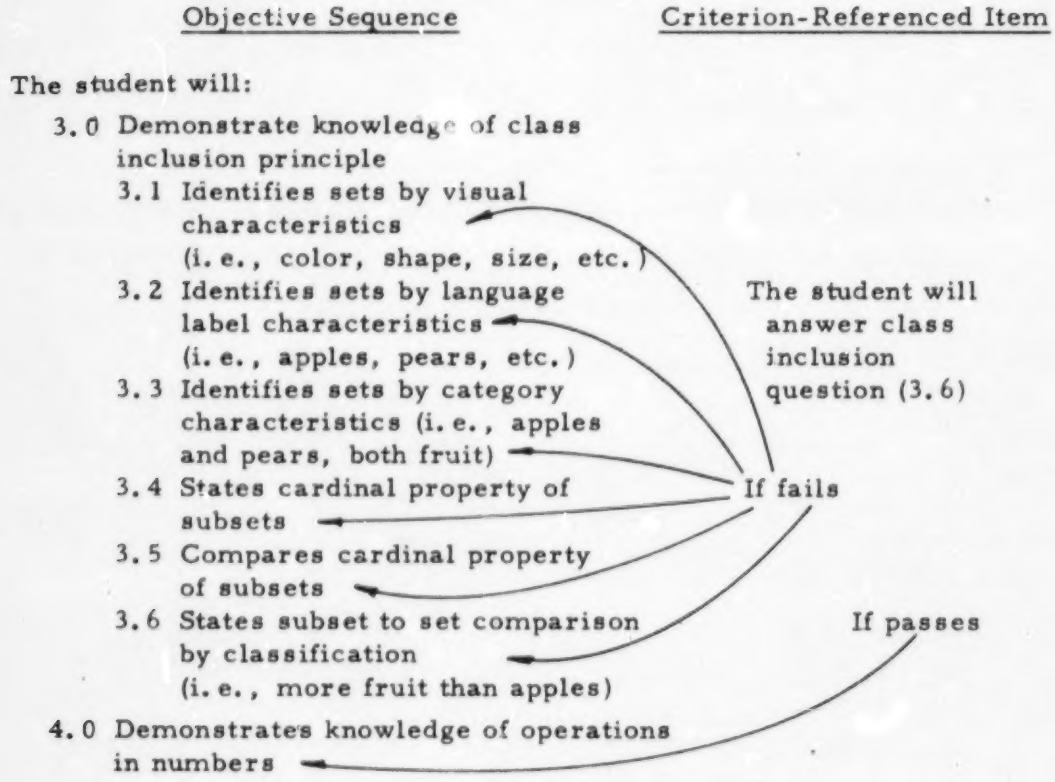
Fountain Valley Teacher Support System in Mathematics

(Richard L. Zweig, Associates, Inc.)

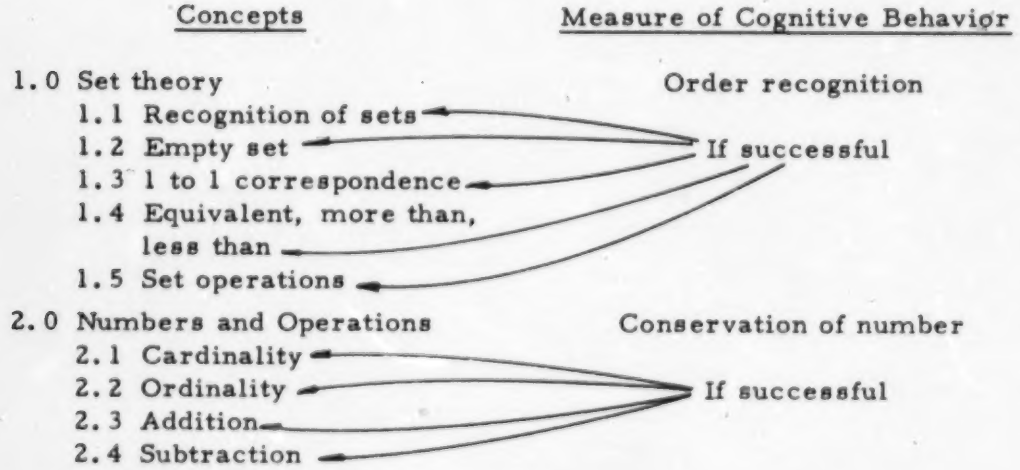
The Fountain Valley Teacher Support System (FVTSS) in Mathematics provides a direct link between a learner's performance on a series of diagnostic math tests and the materials that a teacher could use to teach the skills the learner lacks. The FVTSS in Mathematics contains a series of criterion-referenced diagnostic tests which cover 785 behaviorally stated mathematics objectives suitable for grades K-8. The mathematics objectives cover nine distinct math strands:

FIGURE 2

Example of Criterion-Referencing


Objective Sequence
Criterion-Referenced Item
The student will:
3.0 Demonstrate knowledge of class inclusion principle
3.1 Identifies sets by visual characteristics (i.e., color, shape, size, etc.)
3.2 Identifies sets by language label characteristics (i.e., apples, pears, etc.)
3.3 Identifies sets by category characteristics (i.e., apples and pears, both fruit)
3.4 States cardinal property of subsets
3.5 Compares cardinal property of subsets
3.6 States subset to set comparison by classification (i.e., more fruit than apples)
4.0 Demonstrates knowledge of operations in numbers
The student will answer class inclusion question (3.6)
If fails
If passes

Example of Concept-Referencing



(1) numbers and operations, (2) geometry, (3) measurement, (4) applications of mathematics, (5) statistics and probability, (6) sets, (7) functions and graphs, (8) logical thinking, and (9) problem solving.

The direction for each of the tests is recorded on audio cassette tapes so that they may be used by groups or individual children. Each test is on a two-part sealed piece of paper designed in such a way as to be self-scoring. Number codes on the correction sheet indicate the objective each item was intended to measure. The teacher merely notes the number codes for the items a learner missed and records the information on an Individual Continuous Pupil Progress Profile. The teacher then consults the Teacher's Manual for a further explanation of the objective code or the Teaching Alternatives Supplement to the Teacher's Manual if she desires to know which basal mathematics texts or supplementary audio-visual programs cover that specific objective. The major basal tests and A-V supplements have each been analyzed in terms of the 785 objectives and cross referenced with page numbers in the texts back to each item on the tests. The end result is a direct link between the test and the instructional options.

The system allows for a great deal of flexibility on the part of the teacher. It permits the teacher to build an individualized program for learners with disabilities in mathematics. The cost for each level of the system (of which there are nine) is about $135.

Prescriptive Materials Retrieval System (Select-Ed, Incorporated)

The Prescriptive Materials Retrieval System (PMR System) is a commercially available program which has cataloged 8,000 print and non-print instructional materials. The system was designed to allow a teacher to match learner characteristics with material characteristics. The system was formulated specifically with the handicapped learner in mind; that is, a learner who shows a discrepancy between his expected level of achievement and his actual level of achievement. Using the PMR System, a teacher can identify materials that teach a specific content, that are set into a specific format (for example, filmstrip, programmed instruction, etc.), that are written according to a specific reading level, and that fit a specific instructional strategy. The problem with most retrieval systems (for example, a card catalog in a library) is that you can only specify one variable at a time. With the PMR System, several variables can be specified and a search done accordingly.

The PMR System has five basic components: (1) a thesaurus with over 400 descriptors (95 descriptors in mathematics) covering 12 subject areas; (2) a descriptor card file; (3) a code reading light box; (4) Materials Analysis Sheets; and (5) Basic Educational Skills Inventories in Math and Reading.

The Basic Educational Skills Inventory in Math (Select-Ed, 1972) contains 433 items that have been divided into 20 sections. Each of the items is cross references on the scoring sheet with a PMR System number and descriptor. A student doing poorly in a section of the inventory might qualify for additional testing or be taught the skills he/she did not demonstrate to criterion. To locate materials that are aligned with the particular skill which each item or cluster of items is measuring, the teacher needs to go to the descriptor card file and locate the materials that are available for teaching the needed skill(s). If the teacher wishes to impose further restrictions on the type of material needed, an additional card can be pulled from the descriptor card file and superimposed on the content card. For example, the teacher may wish to specify that the material be in a workbook format. The descriptor card listing all workbook materials would then be pulled.

These two cards could then be placed upon the code reading light box to determine how many materials are available which meet the two requirements that the teacher has specified.

The teacher next copies down the acquisition numbers of the materials and reads a description of each material meeting the two requirements by consulting the Material Analysis Sheets.

The teacher can then acquire the materials from a distributor or on loan from a materials library. Approximately 55% to 65% of the materials cataloged in the PMR system are readily available in any

well-equipped school district. If the materials are not available, they might be borrowed.

The cost of the PMR System is about $2,000. Periodic updates of the system are available at a cost of about $200.

Key Math (American Guidance Service)

Key Math (Connolly, Nachtman, & Pritchett, 1971) is an individually administered diagnostic arithmetic test that contains 14 subtests organized into three major areas--Content, Operations, and Applications. Historically, diagnostic tests in mathematics have stressed the area of computation. Key Math has broadened this limited focus on math diagnosis and included math concepts and applications. Key Math has grouped the computational aspects of math under the rubric of Operations. Under the area of Content, the authors have incorporated items that deal with the concepts of Numeration, Fractions, and Geometry and Symbols. Applications deal with Word Problems, Missing Elements, Money, Measurement, and Time. Each of the subtests is made up of items which are arranged in order of increasing difficulty. Certain subtests require paper-and-pencil responses (the four subtests dealing with fundamental computations). All of the other subtests require oral responses.

Key Math provides the following information to the teacher: (1) a grade equivalent score which indicates how well the student performed on the entire test; (2) a profile delineating the student's relative performance in each of the 14 skill areas; and (3) a description of each item's content as well as an indication of the student's performance on that item.

Evaluation. Key Math is functional in content. It is very appropriate to use with children who are experiencing specific learning problems. It requires almost no reading or writing ability. The administration format is extremely easy to follow and gives the teacher the opportunity to be involved in relevant diagnosis. The manual also presents instructional implications based upon the child's performance on the various subtests. The authors have cross referenced each of the items on the test with specific behavioral objectives. They have included this information in Appendix A of the manual. The authors also encourage the teacher to examine the item-by-item performance of the learner for the purpose of planning additional testing or a corrective program. The Diagnostic Profile makes it very easy to see a student's item performance at a glance.

Development of the instrument was initiated in 1961. Field tests have involved over 2,900 pupils in 20 states. Item analysis was conducted related to the performance of 951 subjects in grades K-8. Normative data were gathered on 1,222 subjects in grades K-7.

Correlations range from .94 to .97. Median subtest reliability falls in the range of .64 to .84.

Validity: The selection and sequencing of content in Key Math was based upon an analysis of 10 major mathematics programs.

The Key Math Diagnostic Arithmetic Test has no upper limit for individual remedial use. It does not neglect the diagnosis of computational areas. However, by measuring other mathematical concept skill development, it supports the supposition that diagnosis of other reasoning processes is crucial in the determination of a student's mathematical ability. The approximate cost of Key Math is $25.

Pattern Recognition Skills Inventory (PRSI)

The PRSI (Sternberg, 1975) is a measuring tool and a diagnostic device. It is designed to help educators and other specialists make certain determinations about students, including levels of readiness for functioning in language and mathematics, levels of development of reasoning skills, and appropriate curricular approaches. The inventory is arranged in four equivalent sets, each set consisting of 24 pattern tasks. Only one set (random selection) is presented to the subject. As the teacher presents each task, he or she instructs the subject to (1) view the model pattern sequence, (2) view the four-choice array of pattern sequences, and (3) make a choice from this array. Each student's response is recorded on a response evaluation

sheet. The response evaluation sheet provides information related to three areas: (1) pattern task performance, (2) stimulus dimension performance, and (3) pattern performance. The author has related these performance areas to basic instructional implications in language and mathematics. The implications (concepts) are listed in figures that are present in the Teacher's Manual. PRSI can also be used to develop pattern recognition skills. The teacher presents one set as a pre-test, uses another two sets for instruction, and uses the remaining set as a post-test.

Evaluation. This instrument has been under development since 1972. During this time four research studies have been conducted involving the testing of over 500 students. Normative data were gathered on normal subjects (preschool through fourth grade) and handicapped students (primary, intermediate, and junior high school).

The PRSI is a concept-referenced tool which attempts to take a specific behavior (pattern recognition) and relate it to other conceptual areas (language and mathematics). It requires no reading on the part of the student. It was expressly designed for use by teachers. The instructional implications figure pertaining to mathematics provides concepts listed in developmental order. The real emphasis of the PRSI is in instructional implications. In that the inventory is comprised of four equivalent yet different task sets, the teacher may use the materials, if she so desires, to teach pattern recognition, a

prerequisite skill to language and mathematical skill development. The approximate cost of PRSI is $85.

Verbal Problem Solving

To satisfy the "relevancy" dimension of the curriculum model described previously and also the concept development emphasis, a verbal information processing component is essential.

Verbal problem solving deals with mathematical problems that are embedded in verbal phrases. In the past, problem-solving instruction was conducted in a very unsystematic fashion. The following discussion outlines a procedure for diagnostically teaching problem solving to delinquent youth so as to systematically control the variables present in word problems. It also shows how to minimize computational and reading difficulties and maximize the active processing of information on the part of the learner.

A verbal problem is a statement or statements accompanied by question, presented orally or in written form, that should require reasoning and quantitative thinking on the part of the learner to arrive at the correct answer. In addition, a verbal problem is person, time, and event specific. The following examples should clarify this point:

Determining how much interest $100.00 will earn at six percent compounded semi-annually may be a "problem" for a fourth grade boy,

but it certainly would not be a problem for a certified public accountant. This is an example of a person-specific problem. For the certified public accountant, supplying the correct answer might merely involve the application of a rule or the recall of factual information and therefore would not be a "problem." In several years, the preceding example may cease to be a problem for the boy who is in fourth grade in that he has gained certain basic skills that have become an ingrained part of his behavioral repertoire.

An example of an event-specific problem is one in which a person is asked to find the floor area of a square room. The child may experience no difficulty in solving this problem. However, by presenting the same child with a floor plan of a room that has one or several offsets, he may be unable to provide a solution. What we have done is changed the events or stimulus conditions.

A time-specific problem can be shown by a person's inability to solve a problem at an early age but finding no difficulty solving the same problem when he is older. Once a person has successfully solved a problem and is able to successfully complete similar problems in a consistent fashion, the task ceases to be a "problem" for the person. Solving a problem requires something more than the rote application of a rule.

Understanding a little bit about person variables, time variables, and event variables will help a great deal in diagnostically teaching verbal problem solving to delinquent youth.

Since verbal problems are person, time, and event specific, students within any given class will be operating on a variety of levels in terms of being able to solve word problems that appear in their textbooks or that are teacher made. Being able to supply different students with a variety of problem types should be a great aid to facilitate the problem-solving process. However, to do this indiscriminately may not help the teacher to determine the reason for an incorrect response on the part of the learner. For this reason any problems that are given to a learner to solve should be analyzed in terms of their component parts or parameters. In other words, the teacher should construct problems in a systematic fashion so that she is aware of what factors are operating within the framework of the verbal problem.

To write word problems which systematically vary on significant parameters or components requires that a model (procedure) be used to write the word problems. The procedure advocated in the following presentation will be that of a matrix.

The basic idea for using a matrix as an organizer of verbal problem characteristics was originally proposed by Cawley (1972). Each cell within the matrix represents a problem that is composed of certain characteristics. These characteristics may be language related, reading related, computationally related, content related, operation related, information load related, etc.

Figure 3 depicts a matrix for indirect verbal problems. The dimensions or components of importance in this particular matrix are number size, reading vocabulary level, and problem type. The problem circled on the matrix would have the following characteristics: fifth-grade reading vocabulary, computation of decimal money with values from $10.00 to $90.00, and operation of addition. A problem that might fall into this cell would look as follows:

> George, the carpenter's helper, had just been paid today. He decided to go out and pay all of his bills. He had $63.00 left after spending $42.00. How much money did he start with?

The next problem would be an indirect subtraction problem and would fall directly beneath the problem we just indicated in the matrix. An example of this type of problem is as follows:

> Frank Wilson now has $37.00 in his wallet. He had won $27.00 of it from Fred in a poker game. How much money did he start out with?

Essentially, the primary difference between the two problems is arithmetical operation; one is addition and the other is subtraction. Number size for the two problems has been controlled as well as vocabulary.

FIGURE 3

UPS Matrix for Indirect Verbal Problems

Operation	Reading Vocabulary Level			Number Size
	3	4	5	
Addition	1	2	3	Decimal money 2-digit. No cents. (e.g., $10.00, $57.00)
Subtraction	4	5	6	
Addition	7	8	9	Decimal money 2-digit. With cents. (e.g., $10.15, $55.37)
Subtraction	10	11	12	

Math Labs

Up to now we have described how four of the five dimensions of a curriculum can be accommodated in mathematics. The final dimension (enhancement of social skills) can be accomplished through the mechanism known as the math lab.

The general purpose of a math lab is to allow a student to explore his environment and to make discoveries based upon quantitative relationships. They can, however, be designed to enhance social skills. Mathematics labs usually revolve around a basic idea or a basic theme. One component of the mathematics lab requires that the student use certain arithmetical skills which he has previously mastered. The purpose of a lab in our view is not for the purpose of developing new math skills but rather to expand a child's understanding of the physical environment. The topics for math labs can be in the areas of economics, science, geography, history, and even language arts. Schminke, Maertens, and Arnold (1973) suggest several criteria that can be applied to assess the potential of various environmental arrangements for conducting a mathematical laboratory. These are as follows:

1. Does the choice really promote mathematics as a system of ideas?

2. Does the choice stimulate people initiative and self-reliance?

3. Does the choice encourage a unique teaching style and unique learning style of the group of children?

4. Does the choice accommodate discussion and exploratory responses?

5. Is the choice generally appropriate for the desired learning?

(Schminke, Maertens, & Arnold, 1973, p. 81)

Cawley (N. D.) suggests that the purposes of a mathematical laboratory are as follows:

1. To provide the learner with an opportunity to practice selected number skills in real and vicarious experiences.

2. To provide the instructor with an opportunity to develop experiences that will extrapolate the learning activities over a period of time.

3. To develop in the learner selected quantitative and quantity related skills specific to a particular cognitive strand.

4. To provide a combination of experiences that will elicit quantitatively related principles and roles.

5. To provide a socially responsible or interactive experience in which to reinforce quantitative and behavioral characteristics.

Essential Components of Math Laboratories

It appears as if math labs must concentrate on three distinct areas: (1) social responsibility development, (2) arithmetic skill

utilization, and (3) arithmetic concept development. For delinquent youth, probably the most essential component is that of social responsibility. One purpose of math labs is to have students apply mathematics to specific real-life situations. Therefore, each student must be made aware of his/her behavioral responsibilities within the group for completion of the activity. For example, every student participating in a math lab will not necessarily be doing the same thing. One student's responsibility might be to plan a sequence of tasks. Another might be required to collect and collate specific data that are obtained from the daily math lab activities. Still another might be asked to perform some specific mathematical operation on the data so as to have a basis for the next day's activities. The key point here is that each student has a task to do, a social responsibility to the rest of his/her group. The requirements are that each student is made aware of these responsibilities and understands that meeting them will aid not only that specific student but also the rest of the group participating in the math lab.

The second area of the math labs is arithmetic skill utilization. This refers to the prerequisite abilities that a student must have in order to complete the laboratory. These skills must also be carefully delineated by the teacher so as to afford her the opportunity of instructing the students in specific mathematical skill development if these are lacking. Also, as stated previously, given individual student's mathematics concept development, not all students will be required to

demonstrate the same utilization of arithmetic skills. This allows for extreme flexibility as well as individualization of programming.

Arithmetic concept development refers to the specific mathematical principles that hopefully the student will understand as a result of the mathematics laboratory. In essence, the concept is a result of the application of the arithmetic skill to a real situation. For example, a student may bring the arithmetic skill of averaging numbers to the lab. He then applies the skill to a specific situation (that is, average number of garbage cans in front of each house in a suburban area versus an inner-city area). Combined with other variables (that is, average amount expended by a homeowner per garbage can), the concept that is hopefully developed is an environmental area-rate structure-cost interaction based upon the question: Who receives the best sanitation service?

The following is an example of a Mathematics Laboratory.

MATH LAB 25

LAB: Prices Over Time in Newspaper Food Ads

LENGTH: 4 - 6 Weeks LEVEL: Senior

SOCIAL SKILLS TO BE DEVELOPED:

1. An increased feeling of responsibility by collecting the newspaper ads each week and bringing them to class when required.
2. A greater skill in communicating with peers by presenting the findings to them.
3. A greater ability to make decisions by choosing certain products to examine.

ARITHMETICAL CONCEPTS TO BE DEVELOPED:

1. Sequence of days, months.
2. Comparison of prices over time.
3. Simple chart and graph construction.

SKILLS NEEDED FOR LAB:

1. Reading newspaper ads.
2. Reading money notation--dollars and cents.

INTRODUCTION:

Part I

The key behavior in this part is the collection of the newspaper ads during the weeks that the lab takes place. This must be done so that the rest of the lab can be done.

Part II

The behavior to be stressed in Part II is deciding on certain items to chart and doing this each week. Part II must be done so that the learners can present their findings to the others.

Part III

The important behavior in this part of the lab is the presentation of each learner's findings to the class. Stress to the learners that their presentations should be brief but should convey the important information necessary to make a comparison of prices over time in various supermarkets.

INSTRUCTIONS:

Part I - Have the learners:

1. look in newspapers for the supermarket food ads.
2. collect ads each week for 4 to 6 weeks for one supermarket chain.

3. bring these ads to class at the end of the 4 to 6 weeks' period. Date each ad.

4. choose different supermarkets for comparison.

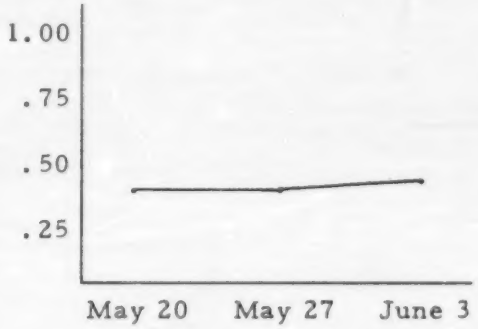
Part II - Have the learners:

1. examine their ads and note at least 5 different items which are advertised every (or almost every) week.

2. make a chart listing these items and their prices for each week that ads were collected; for example:

Item	Prices Each Week		
	May 20	May 27	June 3
1 qt. milk	.40	.40	.41
1 doz. eggs	.85	.88	.87

3. graph the prices over the weeks; for example:



Part III - Have the learners:

1. present their results to the other learners.

2. discuss the findings.

PROBE QUESTIONS:

Was the trend in food prices over the week steady?

Did the prices rise? Did they fall?

What products seemed to have the greatest rise in prices?

Did any of the supermarkets raise their prices more than others?

What are some reasons for the rise in food prices?

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